

WHAT IS CLAIMED IS:

1. A variable optical attenuator which comprises an incoming fiber for propagating an incoming light beam, a mirror for reflecting the incoming light beam as a reflected light beam, an outgoing fiber for propagating as an outgoing light beam at least one part of the reflected light beam, and an actuator for rotating the mirror so as to vary light intensity of the outgoing light beam, wherein the actuator comprises:

a plate mounting thereon the mirror;
a coil disposed on the plate, a driving current being supplied to the coil;

a housing supporting the plate so that the plate is able to rotate around a rotation axis, which is included on a predetermined plane; and
a permanent magnet which is fixed on the housing and generates predetermined magnetic flux density along the predetermined plane.

2. The variable optical attenuator according to claim 1, wherein the plate is rotatably supported to the housing through two spring hinges positioned at opposite ends of the plate in a direction along the rotation axis.

3. The variable optical attenuator according to claim 2, wherein the each of the spring hinges has a symmetrical shape with respect to the rotation axis.

4. The variable optical attenuator according to claim 2, wherein the plate is made of a metal plate.

5. The variable optical attenuator according to claim 4, wherein the springs hinges are formed integral with the metal plate at the opposite ends of the metal plate.

6. The variable optical attenuator according to claim 1, wherein the predetermined magnetic flux density is substantially perpendicular to the rotation axis.

7. The variable optical attenuator according to claim 1, wherein
5 the rotation axis passes through a center of the coil.

8. The variable optical attenuator according to claim 1, wherein, when the driving current is supplied to the coil, the coil rotates in accordance with a Lorentz force caused by the driving current and the predetermined magnetic flux density so that the plate rotates, and thereby,
10 an attenuation amount linearly responds to the driving current supplied to the coil.

9. The variable optical attenuator according to claim 1, wherein the coil is an air-core coil.

10. The variable optical attenuator according to claim 9, wherein
15 the air-core coil is a winding of a coil material having a self-welding function.

11. The variable optical attenuator according to claim 9, wherein the coil is disposed surrounding the mirror.

12. The variable optical attenuator according to claim 1, further
20 comprising a lens, which is disposed between an end portion of the incoming fiber and the mirror and between an end portion of the outgoing fiber and the mirror.

13. The variable optical attenuator according to claim 1, wherein the incoming and the outgoing fibers are made of TEC (Thermally-diffused
25 Expanded Core) fibers, respectively.

14. The variable optical attenuator according to claim 1, wherein the housing is provided with two terminals which are electrically connected to two ends of the coil.

15. The variable optical attenuator according to claim 14, wherein the two terminals are electrically connected to two ends of the coil via two conductive patterns and two intermediate electrodes.

16. The variable optical attenuator according to claim 15, wherein
5 the intermediate electrodes are formed on the plate and are electrically connected to the respective terminals by the respective conductive patterns, while electrically connected to the respective ends of the coil, and a pair of the conductive pattern and the intermediate electrode is electrically
10 insulated from the other pair of the conductive pattern and the intermediate electrode.

17. The variable optical attenuator according to claim 1, wherein the plate has two surfaces, on one of which the mirror and the coil are disposed together.

18. The variable optical attenuator according to claim 1, wherein
15 the plate has two surfaces, on one of which the mirror is disposed, while the coil is disposed on the other surface of the plate.

19. The variable optical attenuator according to claim 1, wherein the coil is comprised of two coil components, and the plate has two surfaces on both of which the respective coil components are disposed.

20. The variable optical attenuator according to claim 1, further
20 comprising a single ferrule, within which end portions and portions near thereto of the incoming and the outgoing fibers are fixed.

21. A variable optical attenuator device comprising a plurality of variable optical attenuators, each of the variable optical attenuators
25 according to one as claimed in claim 1, wherein the plurality of variable optical attenuators are arranged side by side so that each of the attenuator uses in common to at the adjacent one of the variable optical attenuators a single one of the permanent magnet disposed between them.